PREVIOUS SHORT COURSES

Allison-Marshall Development Co., Calgary, Alberta, Canada

Ames Research Center, Moffett Field, California

Boeing Airplane Company, Wichita, Kansas

Goddard Space Flight Center, Greenbelt, Maryland

Holloman Air Force Base, New Mexico

Honeywell, Inc., Denver, Colorado

Jet Propulsion Laboratory, Pasadena, California

Marshall Space Flight Center, Huntsville, Alabama

National Institute of Reliability, Copenhagen, Denmark

U.S. Navy Ordnance Laboratory, White Oak, Maryland

U.S. Navy Underwater Sound Lab, New London, Connecticut

University of California Extension, Los Angeles, California

University of Southampton, Southampton, England

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DESCRIPTION

The three-day short course comprises a series of lectures and related written material covering principles and latest techniques of random data measurement, analysis, and interpretation. Current analog and digital data processing procedures are discussed, together with associated equipment errors and statistical estimation criteria. Knowledge of these topics is essential for engineers and scientists dealing with random data either for research studies or for practical applications, who wish to be informed about recent developments.

The one-day MAC/RAN* presentation is given following the short course, and explains and illustrates the MAC/RAN System of digital computer programs for processing random data. These programs are available now to users to carry out computations for immediate and future random data analysis requirements.

APPLICATION AREAS

Random data, also called time series data or stochastic data, refers to any data sample, regardless of its origin, which has no explicit mathematical formula but instead must be described in terms of probability statements and statistical averages. Since there is strong justification to consider much natural physical phenomena as random, applications are quite extensive. Various application areas for random data analysis are listed below:

Applied Research and Development, Astronomy and Space Sciences, Biomedical Research, Communication Systems, Data Analysis and Computation, Environmental Tests and Specifications, Laboratories and Instrumentation, Measurement and Noise Problems, Meteorology, Nuclear Power, Oceanography and Undersea Technology, Psychological Research, Reliability and Safety Standards, Seismic and Geological Data Analysis, Structural Design and Criteria, Vibration and Acoustics.

EXPECTED BENEFITS

Some of the expected benefits for participants in the course and demonstration are:

- Increased awareness of the importance of random process theory to describe and solve many physical and engineering problems in industrial and government applications.
- New insights into the latest ideas and techniques which have been developed and are employed in various advanced research and development activities throughout the country.
- Standardization of definitions, notation, analysis procedures and presentation of results, to improve accuracy and acceptance of work between various user groups and the general industry.
- Introduction to the MAC/RAN System of digital computer programs for processing random data, and better understanding of current software technology.

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SCHEDULE

THREE-DAY SHORT COURSE
MEASUREMENT AND ANALYSIS OF RANDOM DATA

First Day (Monday)

1. Descriptions of Physical Data
2. Characteristics of Physical Systems
3. Mathematical Theory for Random Data

Second Day (Tuesday)

4. Statistical Evaluation of Data
5. Data Collection Systems
6. Data Processing Procedures and Errors

Third Day (Wednesday)

7. Analog Measurement Techniques
8. Interpretation of Special Data Properties
9. Digital Computer Techniques

ONE-DAY PRESENTATION
THE MAC/RAN RANDOM DATA PROCESSING SYSTEM

Fourth Day (Thursday)

1. General Description of the MAC/RAN System
2. Programming Features in MAC/RAN
3. Demonstration of MAC/RAN Results

PREREQUISITE

The course is intended for engineers, scientists, mathematicians and technicians who deal with random data. It is desirable that students have a Bachelor's degree in Engineering, Science, or Mathematics. However, the course material will also prove of significant value to anyone with related experience and current fields of interest.

TEXTBOOK

Measurement and Analysis of Random Data (John Wiley & Sons, Inc., New York, 1966) by J. S. Bendat, President, and A. G. Piersol, Vice President, of Measurement Analysis Corporation.

COST

The fee for the three-day short course is $195.00 per student. The fee covers all course materials, textbook, and luncheons. A check or purchase order should be included with your registration form to guarantee enrollment. There is no charge for the one-day MAC/RAN presentation.

THREE-DAY SHORT COURSE
MEASUREMENT AND ANALYSIS OF RANDOM DATA

1. DESCRIPTIONS OF PHYSICAL DATA
   An introduction is presented to random data principles and engineering applications. The material includes classification for deterministic data as well as for random data. Basic concepts are described for probability density functions, correlation and spectral density functions. Results are illustrated for various types of random data as well as deterministic data.
2. CHARACTERISTICS OF PHYSICAL SYSTEMS.
   A review is presented of basic material on linear system dynamics which is important for many engineering applications. Weighting functions and frequency response functions are discussed for constant parameter linear systems, involving convolution integrals and Fourier transforms. These concepts are illustrated for mechanical and electrical systems.
3. MATHEMATICAL THEORY FOR RANDOM DATA
   Fundamental ideas of probability theory and random process theory are presented. Attention is given to the proper definition and interpretation of stationary correlation and spectral relations, and their transformations by passage through linear systems. Applications are discussed based upon the special theoretical properties.
4. STATISTICAL EVALUATION OF DATA
   General statistical ideas and techniques are discussed which are required for the evaluation of data regardless of its origin. The material covers statistical aspects of parameter estimation using the normal, chi-square, student t, and the F distribution. Other matters discussed include confidence intervals, hypothesis tests, and non-parametric procedures.
5. DATA COLLECTION SYSTEMS
   Instruments in current use are discussed for collecting various experimental data, including transducers, signal conditioning equipment and tape recorders. The basic operating principles of these instruments are described so that an overall evaluation can be made of intrinsic and environmental errors associated with data collection systems. These errors must be considered in estimating accuracy of later data analysis results.
6. DATA PROCESSING PROCEDURES AND ERRORS
   Procedures are discussed for analyzing pertinent properties of a single random data record, and for analyzing a collection of random data records. Theoretical derivations are given for statistical errors in various parameter estimates, and rules are stated for determining required sample sizes and analysis details. Methods are described for evaluating frequency response and coherence properties of single input-output and multiple input-output systems.
7. ANALOG MEASUREMENT TECHNIQUES
   Analog measurement techniques are explained for estimating various parameters of random data such as mean square values, spectral density functions, correlation functions, and probability density functions. The discussion includes a treatment of instrument errors and practical operating procedures.
8. INTERPRETATION OF SPECIAL DATA PROPERTIES
   Data reduction requires interpretation of the analyzed quantities such as power spectra, coherence, and probability density functions. This presentation discusses practical interpretations of special properties in reduced data for detecting matters such as signal clipping, sample record nonstationarities, system nonlinearities, and the presence of multiple input situations.
9. DIGITAL COMPUTER TECHNIQUES
   Digital computer techniques are presented for carrying out the statistical analysis of random data. The discussion includes general requirements, as well as calculation procedures appropriate for single records, joint records, and multiple input-output records. The latest techniques are covered in addition to standard procedures. The MAC/RAN System implements these digital computer state-of-the-art methods.

ONE-DAY PRESENTATION
THE MAC/RAN RANDOM DATA PROCESSING SYSTEM

Special presentations **which will be open to anyone free of charge** will be given on the fourth day (Thursday) in each city at the same hotel where the short course is offered. The day will be devoted to discussing and demonstrating important features in the MAC/RAN System of digital computer programs to analyze random data. The MAC/RAN System implements the procedures discussed in the course to solve random data processing problems for many engineering fields and industrial applications. This software product is available to users now on a long-term lease basis, for immediate installation on a wide variety of digital computers, at their own facilities or at computer service centers.

The following topics will be presented:

1. GENERAL DESCRIPTION OF THE MAC/RAN SYSTEM

   MAC/RAN is a system of digital computer programs developed by Measurement Analysis Corporation (MAC) for processing of RANdom data. The programs are written in FORTRAN IV and provide a comprehensive system for the efficient reduction of random (time series) data in engineering applications areas as discussed in the short course. This lecture presents a general description of the MAC/RAN System and its user oriented design.

2. SPECIAL PROGRAMMING FEATURES OF MAC/RAN

   The MAC/RAN System consists of the following eight basic processing modules:

   1. System Executive Processor
   2. Calibration Processor
   3. Data Preparation Processor
   4. Amplitude Statistics Processor
   5. Time and Frequency Analysis Processor
   6. Linear Systems Analysis Processor
   7. Fast Fourier Transform Processor
   8. Printer and Plotter Output Processor

   The lecture describes special programming features of these processors, as well as the Add-On Capability of MAC/RAN to incorporate new modules easily.

3. DEMONSTRATION OF ENGINEERING APPLICATIONS USING MAC/RAN

   Several applications of results from analyzing engineering data are illustrated using the MAC/RAN System. These applications indicate some of the advanced concepts in MAC/RAN which provide ease of operation, overall data processing efficiency and large throughput time savings. The adaptability of MAC/RAN to solve problems for different users is also covered in this demonstration by showing examples of plotted outputs where different computers and different procedures give equivalent results.

LECTURERS

JULIUS S. BENDAT, President
TECHNICAL SPECIALTIES: Applied Mathematics, Physical Research, Principles and Applications of Random Noise Theory, Measurement and Analysis of Random Data

LOREN D. ENOCHSON, Vice President
TECHNICAL SPECIALTIES: Applied Statistics, Test Procedures, Digital Computer Programming, Real Time Systems, Oceanographic, Seismic and Vibration Data Analysis

RONALD D. KELLY, Instrumentation Manager
TECHNICAL SPECIALTIES: Instrumentation Evaluation and Techniques, Environmental Measurements, Design Criteria and Test Specifications, Data Collection Systems

ROBERT K. OTNES, Senior Staff
TECHNICAL SPECIALTIES: Data Processing Equipment, Input-Output Computer Programs, Numerical Filtering, Telemetry Data Analysis

ALLAN G. PIERSOL, Vice President
TECHNICAL SPECIALTIES: Structural Dynamics, Reliability Engineering, Shock, Vibration and Acoustic Measurement Techniques, Analysis and Interpretation of Random Physical Data

GEORGE RICHMAN, Senior Staff
TECHNICAL SPECIALTIES: Digital Computer Programming, Large-scale Data Processing Applications, Time Series Analysis

LOCATIONS AND DATES

The three-day short course and accompanying one-day MAC/RAN presentation will be held at conveniently situated hotels in four cities: Washington, D.C.; New York, N.Y.; Los Angeles, California, and Houston, Texas. Accommodations should be arranged with hotels as desired by attendees. The locations and dates are as follows:

Statler Hilton 16th and K Streets, N.W. Washington, D.C.	November 6-9, 1967
Statler Hilton 7th Avenue and 33rd Street New York, New York	November 13-16, 1967
Statler Hilton 930 Wilshire Boulevard Los Angeles, California	January 15-18, 1968
Shamrock Hilton Main at Holcombe Boulevard Houston, Texas	February 12-15, 1968

ABOUT MEASUREMENT ANALYSIS CORPORATION

Measurement Analysis Corporation is a research, engineering and application software organization specializing in the theory of random processes and the solution of engineering problems. The MAC staff comprises personnel professionally skilled in mathematics, physics, and engineering, with an average of more than ten years of experience in their disciplines. Areas of work include:

- general research in the mathematical and engineering procedures for analyzing and interpreting random processes in physical problems
- investigations of the practical requirements to create design criteria from analyzed physical data
- evaluations of existing procedures and instrumentation for acquiring and analyzing physical data
- studies of new analog and digital techniques and development of computer programs for determining the properties of random data
- processing data and conducting physical research in MAC's Data Processing Center and Research Laboratory
- educational courses in the measurement and analysis of random data for engineering applications

REGISTRATION FOR SHORT COURSE AND MAC/RAN PRESENTATION

Name: _____

Title: _____

Company: _____

Address: _____

_____ Zip Code _____

Telephone: _____

Please register me for both the three-day short course in **Measurement and Analysis of Random Data** and the one-day presentation on **The MAC/RAN Random Data Processing System** at the location checked below:

☐ Washington, D.C., November 6-9, 1967
☐ New York, New York, November 13-16, 1967
☐ Los Angeles, California, January 15-18, 1968
☐ Houston, Texas, February 12-15, 1968

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Please register me **only** for the one-day presentation on **The MAC/RAN Data Processing System** to be given in _____

on Thursday _____.

NOTE: Complete information on meeting agendas will be sent to each registrant at least one week prior to the starting date.

_____
Signature